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Industrial Automation

Types of Pressure:
When and Why Are They Used?

A WHITE PAPER

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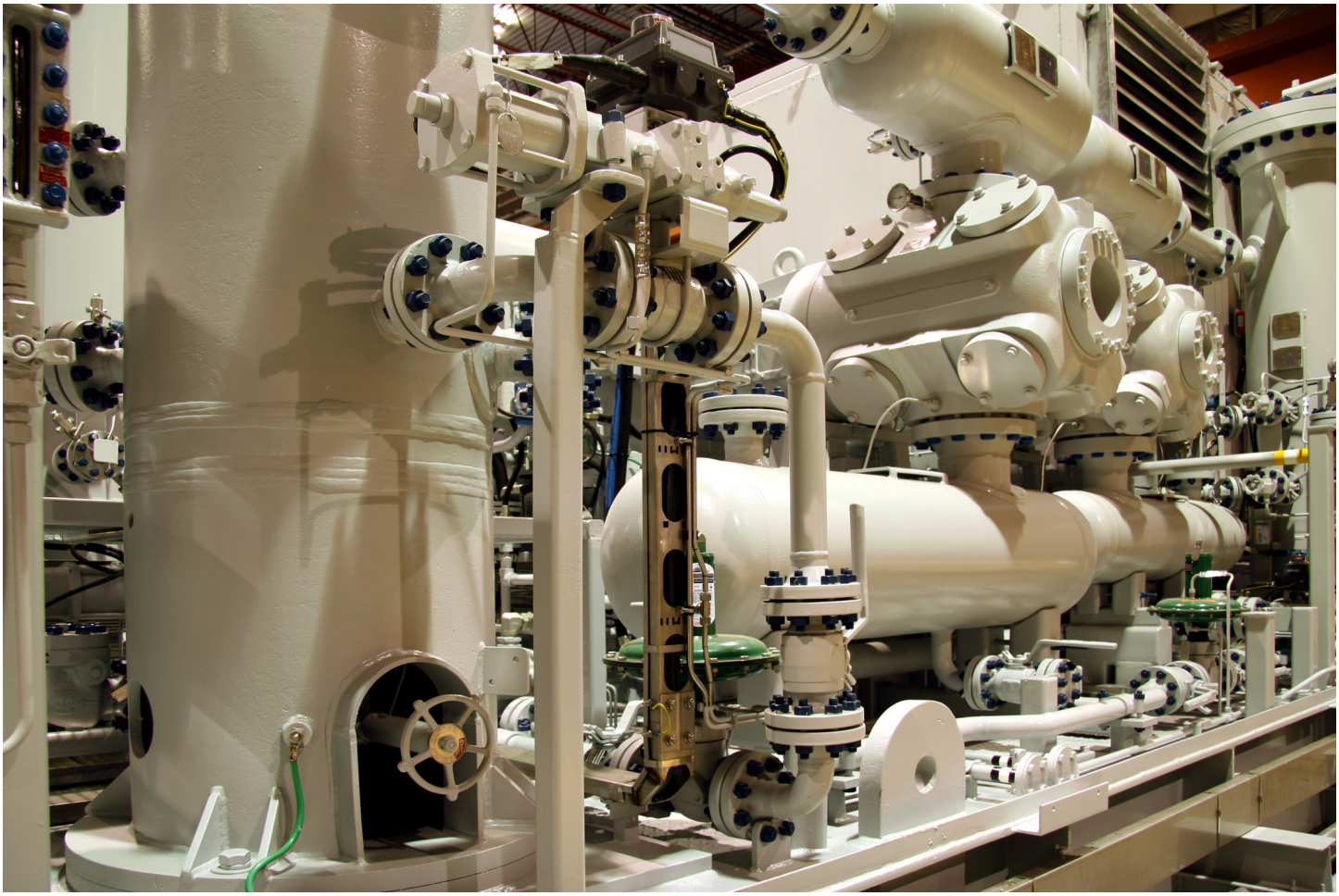

Without measurement there is no control. As with any type of measurement, results need to be expressed in a defined and clear way to allow everyone to interpret and apply those results correctly. Accurate measurements and good measurement practices are essential in industrial automation and process environments, as they have a direct effect on the success of the desired outcome.

Pressure, the measure of a force on a specified area, is a straightforward concept, however, depending on the application, there are many different ways of interpreting the force measurement. This white paper will identify the various units of pressure measurement, while discussing when and why certain pressure measurements are used in specific applications.

PRESSURE MEASUREMENTS

When measuring pressure, there are multiple units of measurement that are commonly used. Most of these units of measurement can be used with the international system of units, such as kilo, Mega, etc. These units are defined as follows:

PSI (Pounds per Square Inch): This is the unit of measure for one pound of force applied to one square inch of area. PSI is a typical unit of pressure in the United States.

BAR: One bar is equal to the atmospheric pressure on the earth at sea level. BAR was a unit of measure created in Europe and is still commonly used there.

PA (Pascal): This is the unit of measure for one newton of pressure per square meter.

InHg (Inches of Mercury): This is the unit of measure for a one inch circular column of mercury, one inch tall, at gravity and 0°C (32°F). InHg is typically used as a unit of measure for barometric pressure.

Torr: This unit was initially developed as a millimeter of mercury and is a very small fraction of atmospheric pressure.

InH_2O (Inches of Water): This is the unit of measure for a one inch circular column of water, one inch tall, at gravity and 4°C (39.2°F). InH_2O is typically used for a differential pressure measurement, or in low pressure water applications, such as level.

REFERENCING PRESSURE

There are multiple ways in which pressure can be referenced. To accurately identify and relay pressure measurements, the application must be considered. Pressure sensors use the following references:

Gauge Pressure

Gauge pressure uses a reference to the atmosphere around the sensor. Because the sensing element has a deflection due to a pressure change, a reference point is needed to know exactly what pressure is being measured. Pressure sensors that use gauge pressure—typically seen in PSIG, BARG, kPaG, etc.—have some type of vent. This vent can be built in to the sensor or even through a tube in the electrical connection. The vent is in place to use atmospheric pressure as a reference point for the sensor to measure the media. One common reason for using gauge pressure is to ensure that with any location throughout the world, the sensor will always reference the location in which it is installed.

Absolute Pressure

Absolute pressure uses a reference to a perfect vacuum. This type of pressure reference is the gauge pressure of the media, in addition to the pressure of the atmosphere. As locations are changed, especially when dealing with elevation changes, the reference point can change because of atmospheric pressure differences. Using an absolute pressure sensor eliminates the reference to a varying atmospheric pressure and relying on a specific pressure range for reference.

Differential Pressure

Differential pressure can be a little more complex than gauge or absolute, but is simply measuring the difference between two medias. Although most gauge pressures are technically a differential pressure sensor—measuring the difference between the media and atmospheric pressure—a true differential pressure sensor is used in order to identify the difference between the two separate physical areas. For example, differential pressure is used to check the pressure drop—or loss—from one side of an object to the other.

Sealed Pressure

Sealed pressure is less common than the previous three but still has a place within the pressure world. Sealed pressure uses a pre-determined reference point, not necessarily

vacuum. This allows for pressure measurement in locations that will vary with atmospheric changes. Because of the pre-determined reference point, no venting is needed on the sensor.

CONCLUSION

In many applications, absolute pressure is specified without any real need for it. There is a misconception that all pressure measurement needs to be absolute. While there is certainly a need for absolute pressure measurement, the majority of applications only need gauge pressure, or another alternative. By understanding the application details, selecting an appropriate pressure sensor can be easy. A correct pressure sensor allows for more precise processes and for a proper outcome in the most efficient and economical way possible.